DOCUMENT RESUME

ED 157 666 RC 010 642

AUTHOR	Chapman, E. Wayne, Comp.; Waters, Robert E., Comp.
TITLE	A Teacher's Manual for Outdoor Classrooms -- How to Plan, Develop, and Use Them.
INSTITUTION	Soil Conservation Service (DOA), Auburn, Ala.
PUB DATE	[73]
NOTE	65p.; Not available in paper copy due to marginal legibility of original document
EDRS PRICE	MF-$0.83 Plus Postage. HC Not Available from EDRS.
DESCRIPTORS	*Activities; Agency Role; Art; Community Cooperation; *Conservation Education; Curriculum Development; *Educational Resources; *Elementary Secondary Education; Health Education; Illustrations; Instructional Materials; Journalism; Language Arts; Mathematics; Music; *Outdoor Education; Physical Education; Planning; Safety Education; Science Education; Social Studies; *Teaching Guides
IDENTIFIERS	Soil Conservation Service

ABSTRACT

Using experience gained while helping elementary, junior high, and high school teachers plan, develop, and use thousands of outdoor classrooms, the Alabama Soil Conservation Service (SCS) produced this teacher's manual for outdoor classrooms. Emphasis is on conservation education and the environment and man's relationship to it. Rationale for developing an outdoor classroom, preferably as an integral part of the school site, includes: training in environmental responsibility, expanded learning opportunities for all students, real learning experiences, effective means of teaching conservation. The manual suggests how SCS can help the teacher and outlines steps for beginning an outdoor classroom (including community cooperation, common pitfalls, and 46 specific features that could be incorporated). Activities listed describe how an outdoor classroom may be used in science (animals, aquatic studies, chemistry, ecology, home economics, geology and soils, plants, vocational agriculture, weather), mathematics, social studies, language arts, art, music, shop, P.E., health and safety, journalism, clubs. The appendix contains a glossary; a list of basic visual and written references and organizations providing free or inexpensive materials; and illustrated teaching aids on the tree, roots and rings, grass and grasshoppers, monarch butterfly, use of the microscope, and bird feeders. (RS)

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A Teacher's Manual For Outdoor Classrooms How To Plan, Develop, And Use Them

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U.S. Department Of Agriculture
Soil Conservation Service
Auburn, Alabama 36830

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A TEACHER'S MANUAL

FOR

OUTDOOR CLASSROOMS--

HOW TO

PLAN, DEVELOP,

AND

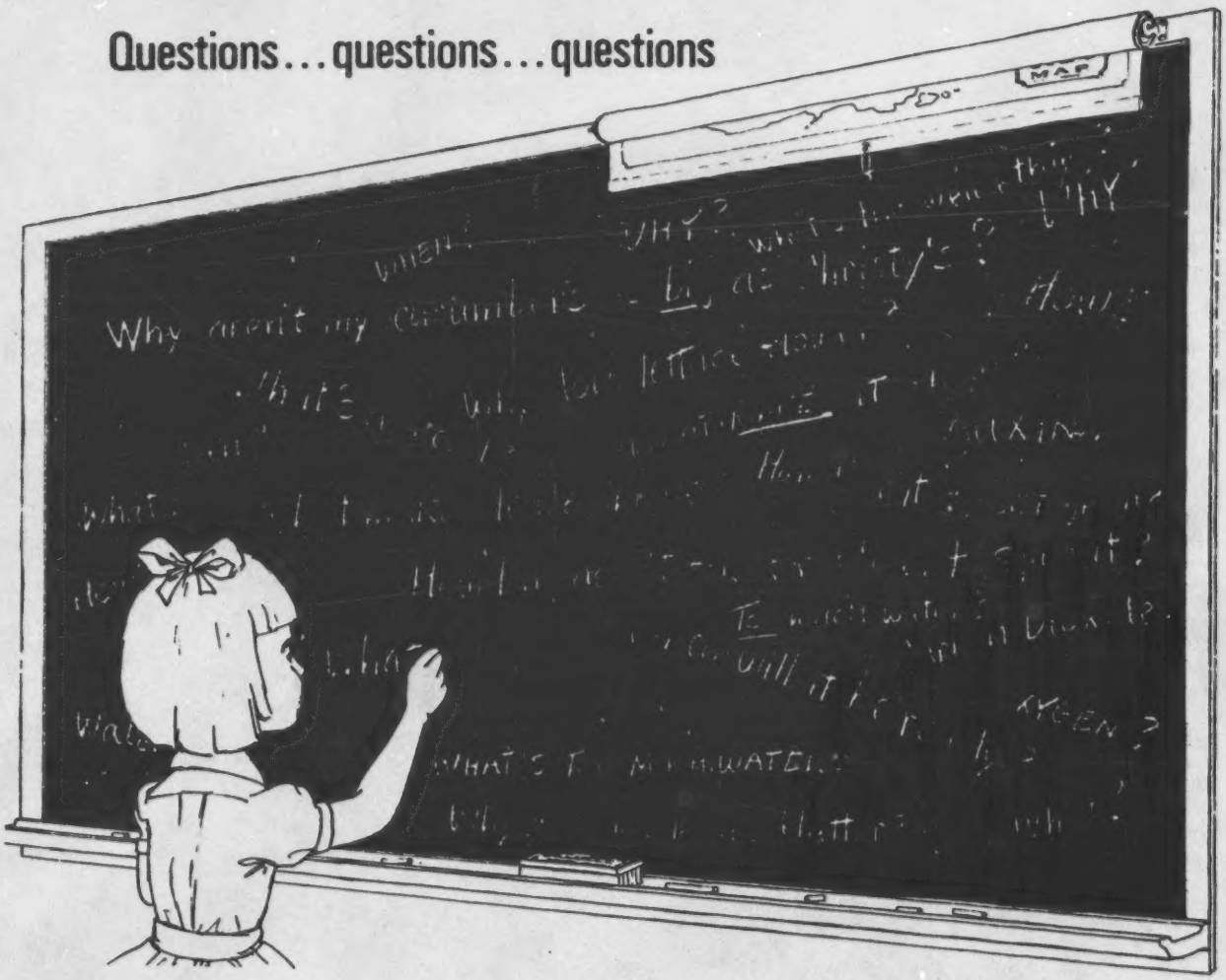
USE THEM

Compiled by
E. Wayne Chapman
State Resource Conservationist

Robert E. Waters
State Biologist

[1973]

Questions...questions...questions



FOREWORD

This teacher's manual summarizes what the Soil Conservation Service has learned while helping enthusiastic teachers plan, develop, and use thousands of outdoor classrooms. We hope that it answers some of your questions about the outdoor-classroom concept.

I encourage you to get copies of the basic references listed in Appendix II and to add them to your reference library.

The Soil Conservation Service has experienced, professional soil conservationists in all Alabama counties. They will be glad to give you more information and to help you with your outdoor classroom.

W B Lingle

W. B. Lingle
State Conservationist
Soil Conservation Service
Auburn, Alabama

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HOW TO PLAN. DEVELOP, AND USE AN OUTDOOR CLASSROOM

I. WHAT ARE OUTDOOR CLASSROOMS?

An outdoor classroom, as an integral part of the school site, expands the learning environment beyond the walls of the traditional classroom. It is a place where the student, through guided personal experiences can become aware of the environment and learn how his decisions and behavior affect the environment for either good or bad. An outdoor classroom consists of real soil, real plants and animals, and real problems for which the student can seek solutions. As a place for authentic experiences, it can give the student a real understanding of the environment and his relationship to it.

II. WHY HAVE OUTDOOR CLASSROOMS?

A. Because the students of today are the leaders of tomorrow. Students are developing lifelong habits and attitudes. Environmental responsibility in the future, as now, must be shared by everyone--not by only trained professionals.

B. Because outdoor classrooms enrich learning opportunities for all students. Students who are disadvantaged by either a lack of books or a low educational environment at home may be seriously penalized by traditional indoor teaching methods. But in the outdoor classroom, they may learn as easily as other students. Outdoor classroom experiences can be adjusted to all levels of learning ability and to all backgrounds.

C. Because outdoor classrooms give the students opportunity for real learning experiences, rather than make-believe ones. Outdoor experiences supplement indoor education. As a place for creative learning, outdoor classrooms give depth, meaning, and new dimensions to lessons about the relationship of man to his environment.

D. Because school grounds should be examples of environmental responsibility. Outdoor classrooms not only help teachers teach environmental responsibility, they are outdoor responsibility because they require good land use planning and development.

E. Because in the long run, outdoor classrooms may be the most effective means of teaching people how to reach conservation goals.

III. WHAT ARE THE ROLES OF THE TEACHER AND THE SOIL CONSERVATIONIST IN OUTDOOR CLASSROOMS?

A. The Soil Conservation Service (SCS) supports conservation education as an integral part of the curriculum in elementary, junior high, and high schools and as part of teacher-education programs in colleges and universities. The SCS conservationist can make contributions to environmental education through his technical knowledge in the conservation of natural resources. These contributions may include technical help in developing an outdoor classroom, information on natural resources, and the development of interpretive materials for school use. Many other agencies and organizations can either help develop the outdoor classroom or provide materials for use by both the teacher and students. Some of these are Alabama Cooperative Extension Service, the Alabama Department of Conservation and Natural Resources, and the Alabama Forestry Commission.

B. For outdoor classrooms to be successful, there must be enthusiastic local leadership, usually from a teacher or principal.

It is, of course, the teacher's responsibility to use the outdoor classroom in harmony with the school curriculum and indoor studies. SCS employees can, however, help with workshops for teachers and help teachers prepare themselves in other ways for outdoor education.

IV. PLANNING THE OUTDOOR CLASSROOM.

A. How do we get started?

1. The principal can appoint an outdoor-classroom coordinating committee. The chairman of the committee may be obvious--there usually is a teacher or a parent who has enthusiasm for the idea. The committee can include:

A member of the school board

A supervisor of the soil and water conservation district

The principal

A teacher

A maintenance man

The president of PTA

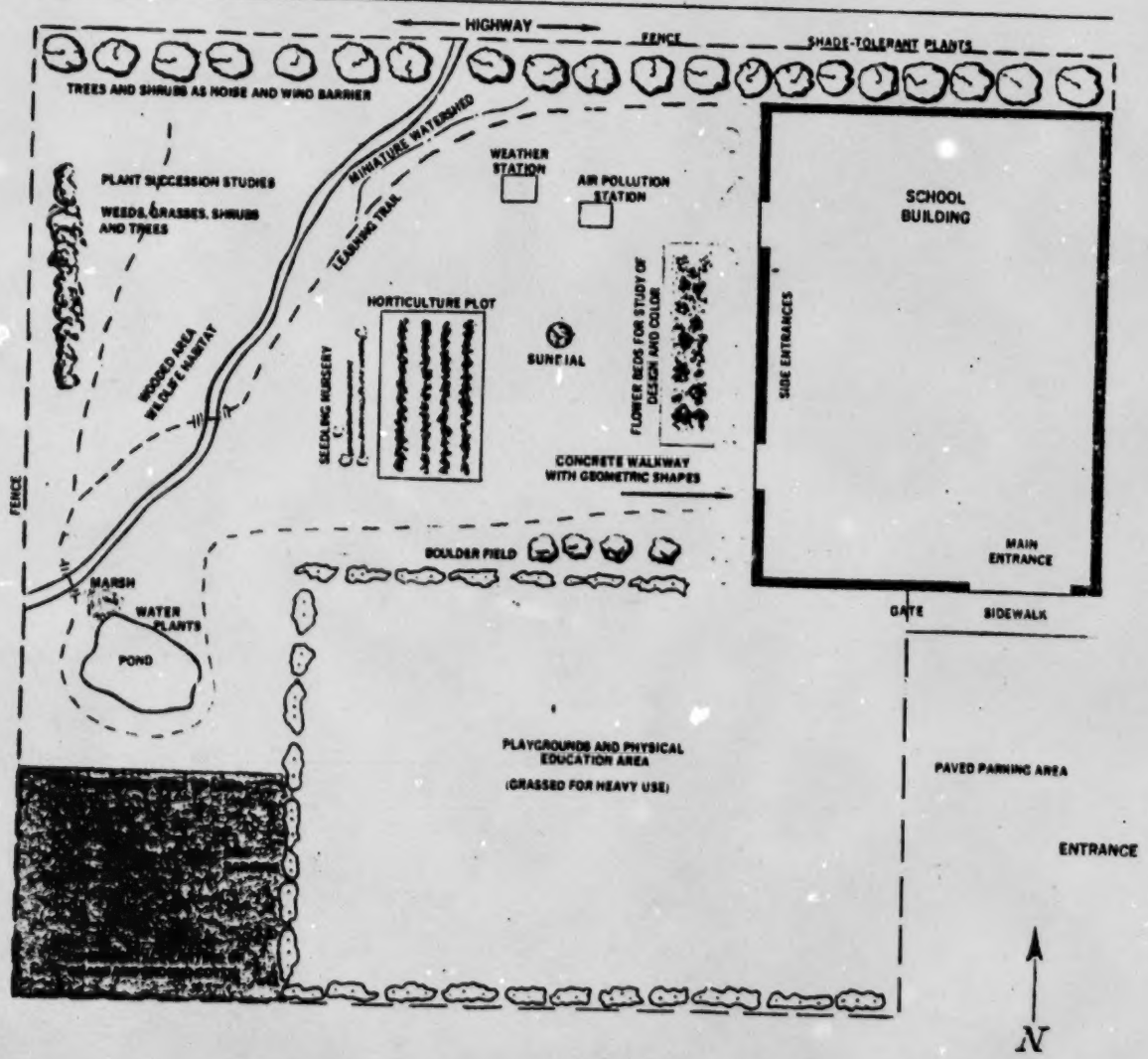
Students

The SCS district conservationist

Resource managers and employees from other agencies

If the committee is appointed before the school is built, the architect should be included.

Parents



A Typical Outdoor Classroom

2. The SCS district conservationist and other resource managers should meet with the committee to explain the assistance available from them and to show either slides or films about outdoor classrooms.

3. The principal may make the school a cooperator with the local soil and water conservation district and ask for help in developing a conservation plan.

4. To be effective, planning must follow a logical sequence:

   a. Determine objectives.

   b. Prepare an inventory of resources on the school ground.

   c. Evaluate the inventory.

   d. Evaluate alternatives.

   e. Make decisions.

   f. Record decisions that are made.

   g. Implement the decisions.

   h. Re-evaluate and update the plan.

5. Surveying the soil is the first step in preparing an inventory. Some classes, especially science classes, may wish to work with the SCS soil scientist while he makes the survey. They can measure slopes, record data, and help in other ways. If the site is used for educational purposes such as this, the school ground is already being used as an outdoor classroom.

6. The chairman of the committee should assign and schedule specific jobs or projects toward developing the conservation plan for the outdoor classroom.

7. One project that nearly all successful outdoor classrooms find essential is the development of a curriculum guide, giving examples of teaching opportunities in the outdoor classroom and telling how to use them. A workbook for students can be developed, also.

8. The outdoor classroom plan may contain large-scale maps. If so, the maps can serve as a permanent exhibit within the school.

B. What are some basic considerations?

Conservation planning and application prevent soil erosion use water correctly, and accomplish other environmentally sound objectives. Certain important factors are basic in developing outdoor classrooms:

1. Natural Areas. Grass, trees, wildflowers, and geologic features such as rock ledges already present should be protected and developed as part of the learning site.

2. Community Eye-Appeal. Conservation practices, especially those following natural contours; landscaped ponds; and ornamental shrubs are only a few of the ways in which outdoor classrooms can be made attractive. A teacher or parent with training in landscape architecture will be valuable to the outdoor-classroom committee.

3. Accessibility. To be effective, outdoor classrooms must be accessible; preferably, they should be located on the school ground.

Yearlong use of an outdoor classroom by families and local groups increases its value to the community.

4. Permanent Displays. Permanent weatherproof markers for identifying and explaining features may be needed in the outdoor classroom. Such aids should not be nailed to trees because they damage trees and are offensive to many people.

5. Safety. Remember that many students will be using the outdoor classroom; therefore, include safety in developing all features.

C. What are some common pitfalls?

1. The Science Only Pitfall. Science teachers may have the most to gain from an outdoor classroom, and it is natural that science teachers take the lead most often. But from the beginning, those involved should seek ways of making the outdoor classroom serve many purposes and be of value to teachers of other subjects. For these teachers, an outdoor classroom may be an entirely new experience.

2. We Don't Have the Money. Some of the most innovative outdoor classrooms have been developed without public funds. Local service organizations, businesses, and parents are often willing to donate needed manpower and materials or to sponsor fund-raising events. Imagination, enthusiasm, and community involvement can overcome the lack of money.

3. The Limited Vision Pitfall. Some visualize an outdoor classroom as a specific physical place, neatly bound. In some cases, a small specific area is set aside on the school ground as part of an outdoor classroom. But the entire school grounds offer opportunities for conservation education. Avoid a limited view that excludes any effective area of the total school site.

4. The Label Everything Pitfall. Labels and signs are often overdone in outdoor classrooms. The student retains lessons better if he or she has authentic, meaningful experiences in the outdoors rather than reads about interesting features. If needed, features can be labeled by numbers that are keyed into curriculum materials so that teachers can carry outdoor classroom experiences over from year to year without interpretive signs.

Students should help in developing an outdoor classroom.

5. Overkill. An outdoor classroom is not like a house that can be completed in a few weeks. It is not a house to be built for students to learn in--it is a place where students can learn to be builders. Therefore, resist the temptations to build an outdoor classroom for students and to build it in a hurry.

D. How large should an outdoor classroom be?

Any accessible area can be used as an outdoor classroom. Some schools and school systems may have large tracts divided into farming areas, forest areas, nature study areas, lakes, and so forth; but most schools have access to only small areas either owned by the school or on adjacent property. The quality of the plan and the enthusiasm of the teachers, students and others involved are much more important than the size of the outdoor classroom.

E. How long should development take?

Active participation in planting trees and shrubs by students increases learning interest.

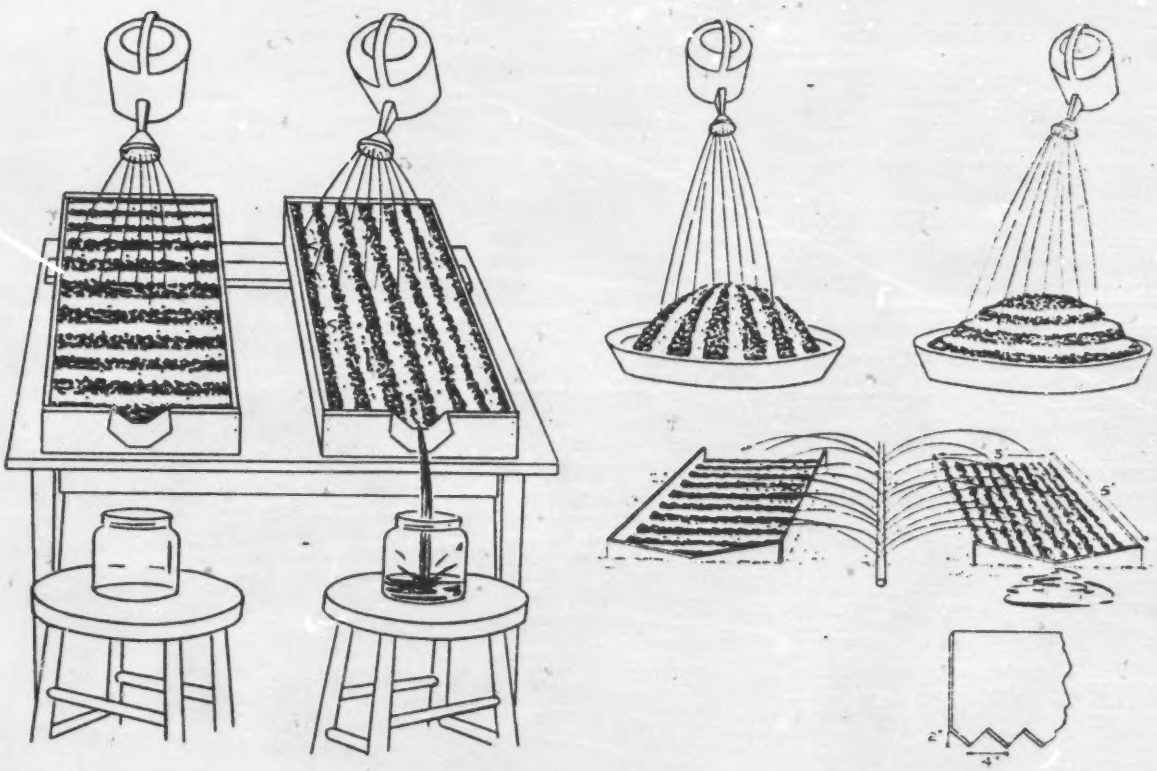
If the special features of an outdoor classroom are installed over a rather long time, more teachers, students, community leaders, and others will be meaningfully involved as the project unfolds. A long-term plan assures more participation.

Teacher training, outdoor class work, and site development can be carried on at the same time. For example, if 500 tree seedlings are to be planted on an eroded area, it may be better to schedule the work over 5 years. More teachers and students can then learn how to plant trees. After the first year, students can observe and compare growth and benefits from trees planted in previous years. Site development and enriching experiences can be spread over many years.

F. What are specific features that can be included?

The sky is the limit. Here are some features that have been included:

1. Conservation Practices - Diversion ditches, tree planting, grassed waterways, ponds, trail mulching, sodding or sprigging and all other conservation practices that are needed to protect natural resources on the site.



What Does Contouring Do?

2. Conservation in Miniature Exhibits - Good in extremely small areas. Miniature terraces, ponds, forests, pastures, and other miniature exhibits can demonstrate conservation principles

3. Living Screens - Frequently, schools are located near noisy highways and railroads. A screen of fast-growing trees can reduce noise, improve the appearance of the school ground, and be a part of the outdoor classroom.

4. Garden Plots - Gardening is a living demonstration of the connection between the soil and human food. Quick-growing vegetables can be used. Gardening is especially valuable because some of the younger students do not know the origin of human foods and the origin of fibers used in man's clothing. "Gardening on the Contour," H&G-179 is available from the local SCS office. Provision should be made in advance for care of the garden during the summer.

5. Pioneer Garden - In this garden, plants that were used in early America can be cultivated. These include Indian corn, gourds, and squash. Scouts find this particularly interesting because many of them have studied Indian culture in their scouting projects.

6. Cross-Tie Garden - If there is not room for a real garden, a pen can be made of old cross-ties and filled with topsoil. (Contractors are generous about giving a truckload of soil for such purposes.) A surprisingly large amount and variety of garden produce can be raised in such a small place. For information on an "adventure garden" for children, write for A Child's Garden--Man's Future on Earth, Reader Service, Chevron Chemical Company, 200 Bush Street, San Francisco, California 94120. Single copies are free.

7. Cotton Patch - Every student knows of Eli Whitney's cotton gin. But how many have picked cotton and separated the seed from the lint? After doing this, lessons on the cotton gin will be more meaningful.

8. Grassland Area - Both native and introduced grasses can be included.

9. Compost Heap - A compost heap can be built on almost any site. A helpful leaflet, "Mulches for Your Garden," H&G-185, is available from the local SCS office.

10. Plant Succession Area - This is an area for studying the various stages of plant succession, starting with bare ground and proceeding to tree growth. The important stages that can be shown are:

    First Stage - Weeds and grasses both annual and perennial flourish for a few years.

    Second Stage - Shrubs and trees such as sumac, sassafras, and persimmon come in, preparing the way for the third stage.

    Third Stage - Trees such as red maple, sweetgum, pine, and hophornbeam come in and provide the necessary environment for the next stage.

    Fourth Stage - Oaks and hickories with some beech and ash dominate and continue reproducing until interrupted by fire, wind, man, or other causes.

    One or more of these stages can be found in nearby woodland.

    Another form of plant succession can be demonstrated at the upper end of ponds where sediment is accumulating. This is a good small-scale example of plant succession from pond to marsh, from marsh to swamp, and from swamp to forest.

11. Pioneer Implements - Hundreds of old turning plows, harrows, corn planters, and many other implements are stored on farms. Many can be obtained at little or no expense. These can be used when studying history and social studies.

12. A Plowed Furrow - Many students have never seen a furrow such as pioneers turned in new ground and prairie sod. Hitch a horse or mule to an old turning plow and plow a short furrow.

13. Forest Management - This area should be selected by a forester and be clearly marked on the plan map. The students should be in on every phase of management from tree planting to harvesting. Demonstrations in proper planting, thinning, and selective cutting can be given. Math classes can use the trees for computing volumes, heights, diameters, and for other purposes.

How Many Uses for Wood Do You Know?

14. Tree Stump - A sloping cut on top of a tree stump or a section from a large tree trunk can be sanded and waterproofed with spar varnish. If a suitable stump cannot be found, a section of log can be buried and one end used. The annual growth rings can be matched with local and national events which occurred during the life of the tree. The events can be listed on an adjacent chart, with dates and a time scale placed on the stump for matching the events. The tree should be as old as possible in order to cover many years. To prevent cracking and decay, paint all surfaces as soon as they are cut with Polyglycol E 1,000 (Dow Chemical)* and Penta (Monsanto)* solutions. The two preservatives should be applied alternately, with drying time between each application.

    Colorful, informative, and interesting pamphlets on tree growth, leaves, tree farms and other subjects can be obtained from:

    Mr. William B. Bunn, Director
    Advertising and Sales Promotion
    St. Regis
    150 East 42nd Street
    New York, New York 10017

15. Turpentine Tree - Either a slash pine or a longleaf pine tree can be tapped for turpentine as part of social studies.

16. Fire Lanes - Woodland and fields contain dry grass that may need protection from fire.

17. Hollow Trees - Hollow trees nearly always attract birds, squirrels, opossums, or other wildlife.

*Trade names are used solely to provide specific information. Mention of a trade name does not constitute a guarantee of the product by the U.S. Department of Agriculture nor does it imply an endorsement by the Department over comparable products that are not named.

18. Water - A pond, seep, or spring greatly multiplies opportunities for studying water, plant, animal and soil relationships. If water is not already present, a pond can be built. Preferably the pond should be at least 1/10 acre in size; but ponds as small as 6 x 10 feet have been used successfully in small outdoor classrooms. Very small ponds can harbor cattails, pickerel weeds, arrowleaf, rushes, and others. Around the edges, moisture-loving plants such as cardinal flowers and liverworts can thrive. Frogs, birds, turtles, and plankton can be studied in the biology lab. SCS can assist in locating the pond site and give technical help. Local contractors, county commissioners, or soil and water conservation districts may be able to provide machinery and other help.

    A spring can be developed if a good bit of water is seeping from the ground. The water can be collected in trenches or troughs and stored in either a spring or small pond. This is a good example of wise use of a resource. The soil conservationist can help in developing the spring or small pond.

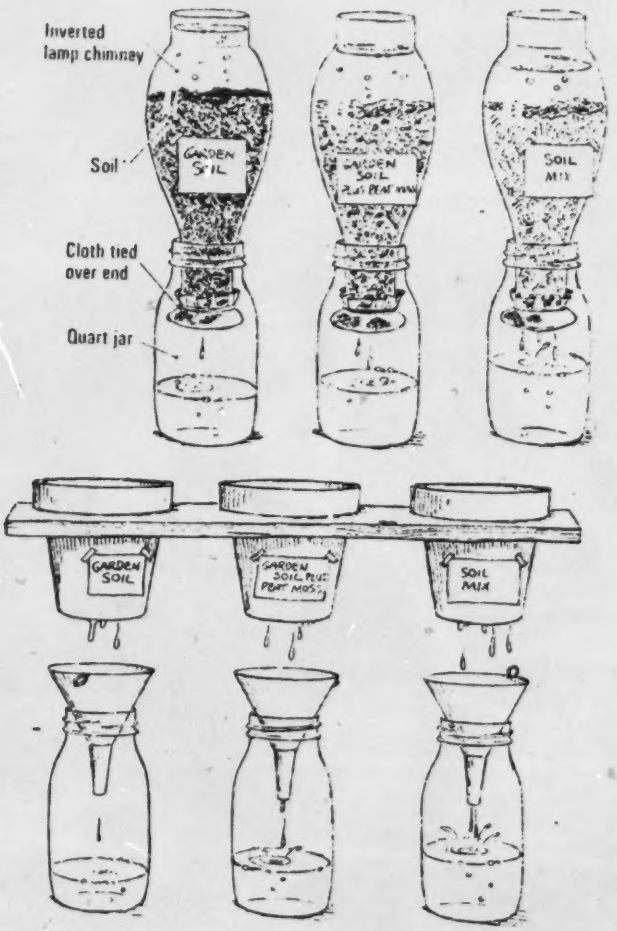
19. Island - If a pond is built as part of the outdoor classroom, an island can be either left or built into it. Plant succession can go undisturbed on the island; and birds and other small animals can use it under natural, but easily observed, conditions.

20. Stream and Watershed - A stream is an ideal illustration of a miniature watershed. Discussion can include the area of the watershed and how rain that falls in the watershed runs into one stream while that falling outside the particular watershed runs into another stream. Students can measure the flow of the stream in cubic feet per second. They can study the slowing down of runoff by vegetation, the movement of soil by the stream, and the deposition of soil in slack areas where the water slows down.

Points of interest can include the action of water as a soil builder, the power of water in soil erosion, the importance of the surrounding watershed, several types of habitats for plants and animals, and environments such as rapids, slack water, pools, and riffles.

21. Erosion Experiment - If a slope of 10 to 15 percent can be located, 6 or 8 runoff plots can be laid out. Boards can be used to separate the plots, and a catch basin can be built at the bottom of each plot to trap soil that moves with the runoff water. Plots can include no cover, grass, row crops, or strip crops.

How Fast Do Soils Take in Water?



Here are two systems for testing the water retention and drainage of soil

22. Permanent Soil Displays - Students should be allowed to experiment with soil directly--not merely look at it. But there may be places where displays can be useful. A soil profile can be placed into a transparent plastic pipe. The pipe can be placed in a hole where the soil profile naturally occurs. The pipe can then be withdrawn and the soil profile studied.

23. Soil Pit - A profile of the different layers of soil can be demonstrated by using a pit or a cross-section of a bank.

24. Soil Thermometers - Thermometers can be used at different locations to measure the effect that grass, gravel or trees have on soil temperatures.

25. Elevated Walkway - A board walk supported by driven poles can be used to carry observers over a pond, wet area, or the water's edge. This permits observation by many people without damage to the area.

26. Map Course - For the study of maps and compasses and for making measurements.

27. Land Measurement - Few people can visualize the surface area covered by 1 acre. One acre of land in a suitable location can be carefully measured and staked.

28. Geology Wall - This is a low stone wall with various rocks and minerals cemented to the top. Students can bring a sample rock from the different areas they visit. After a few years, a great variety of rocks will be accumulated.

29. Rock Garden - The building of a rock garden by using native rocks, native flowers, and native plants can be an unusual learning experience. The rock garden also makes an attractive spot along a stream.

30. Weather Station - This can be very simple (thermometer, rain gage, and hygrometer) or it can be complex, using equipment such as burning index indicators, barometers, and wind gages. Information on setting up a weather station can be obtained from National Weather Service, U.S. Department of Commerce, Washington, D.C. 20235. Writing to the Weather Service and constructing the weather station can be a class project.

31. Sundial - The basis of time and other facts in astronomy can be illustrated by a sundial which can be built by students from inexpensive materials. Complete directions and plans are contained in Sundials, Circular 402, U.S. Government Printing Office, Washington, D.C. 20402. Price is 5 cents per copy.

32. Litter Barrels - Art classes can decorate metal barrels and make attractive litter containers of them. There never seems to be enough litter barrels around.

33. Trails - Trails can vary. In some places, they should be wide enough for two or three people to walk abreast (4 to 6 feet). In other places, they should be wide enough for only single file passage. A space wide enough for the study group to assemble should be provided at points of interest. The surface should be able to withstand traffic. It might consist of natural cover, gravel, wood chips, or even asphalt in high-use areas. Poisonous plants along the trail should be controlled. From a management standpoint, it may be desirable to have trails wide enough to accommodate utility vehicles such as jeeps and pickup trucks.

34. Anti-Vandalism Signs - Signs and labels are subject to vandalism. If signs and labels are used, hang them on days when a particular part of the classroom is to be used and remove them at the end of the day. In this way, students can help take care of the outdoor classroom.

35. Talking Labels - Older students are effective in instructing younger students. Therefore, older students, perhaps as a part of the language arts (speech and English) classes, can write informative material about outdoor classroom features and give it to younger students.

36. Natural Areas - A certain portion of the outdoor classroom, preferably in the most remote section, can be selected as a natural area. It should be clearly marked on the plan map. It should contain no development except trails and a few benches.

37. Fence Row Habitat - If a fence row is present it contains many environmental lessons such as animal trails, bird nests, shrike caches, and the spreading of plants by birds.

38. Food and Cover for Wildlife - Sites for food patches and border plantings can be located and plotted on the plan map. Later, the work can be planned and carried to completion by pupils. There are numerous native shrubs and trees that can be transplanted to produce food for birds, squirrels, rabbits, and other wildlife.

39. Wildlife Shelters - Shelters can consist of either nest boxes for squirrels and other wildlife or simply hollow trees, rock piles, and brush piles. For observation, trails can lead by such shelters.

40. Animal Tracks - Mudflats and sandbars are good places for studying animal tracks. The surface can be smoothed in late afternoon and casts can be made of the tracks found the next morning.

41. Bee Tree - A bee tree can be created by placing a swarm of bees in the natural crevice of a hollow tree. In this type of project, it is necessary to get technical and other assistance from an experienced beekeeper. Remember that bee sting can be fatal.

42. Beehive - Bee trees are desirable, but they are rarities on school grounds. Almost any school, however, with enough space can have a beehive. Again, an experienced beekeeper should supervise this.

43. Birdbath - Birdbaths are simple but they are effective, especially where facilities are limited. A dripping-bucket birdbath is satisfactory. Water drips from the bucket onto a flat rock, then runs into either a concrete pool or a sunken lid from a garbage can. The bucket can be suspended from a tree limb.

44. Bird Feeders - Building bird feeders and placing them on the school ground is a very popular feature of most outdoor classrooms. Blueprints for feeders are available from SCS, the Cooperative Extension Service, and from garden clubs.

45. Domestic Animals - If there is room, a horse, calf, sheep, pig, or goat can help teach lessons in conservation and many other subjects. Your school can keep a ewe that brings a lamb each spring. Later the ewe can be sheared by an experienced farmer. The wool can be carded and actually spun into thread on a spinning wheel. Students can help feed and care for the animals. Adequate supervision and humane treatment are required.

46. Council Ring - A shady, quiet gathering place is appropriate for teaching many outdoor classes. Tree surgeons or city utility maintenance departments usually can be persuaded to donate logs cut into short lengths to serve as benches for a council ring. A carpet can be made from either wood chips or pine bark.

V. HOW ARE OUTDOOR CLASSROOMS USED?

The value of an outdoor classroom may be obvious to teachers of science and social studies. But a teacher of mathematics, domestic science, and other subjects may ask, "What's in it for me, or what's in it for my class?" The following list of activities will help answer these questions:

A. Science

1. Animals

a. Compare animal life found in a woodland community with that found in a stream or pond.

b. Record both the kind and number of birds that visit a bird feeder or are either seen or heard in the outdoor classroom.

c. Observe and describe the behavior of birds.

d. Keep a record of migratory birds, especially the time of year they visit the outdoor classroom.

e. Examine animal tracks found in the soil.

f. Identify and examine plants and animals that help decompose dead animals and plants.

g. Identify and compare animal tracks.

h. Make a count of small animals found near the outdoor classroom.

i. Analyze the material found in nests and other protective shelters of animals.

j. Keep a record of animals observed near the outdoor classroom during early fall and mid-winter.

k. Confine insects in glass jars and study them. Insects can also be mounted and displayed to compare and contrast characteristics.

2. Aquatic Studies

a. Analyze physical and chemical characteristics of either a stream or pond (pH, rate of flow, sedimentation, 0_2, CO_2, and surface and depth temperatures).

b. Study aquatic life such as fish, frogs, salamanders, crawfish, mollusks, insects, and others.

c. Compare aquatic life near the outlet of the city sewer plant with that found at points some distance above and below the outlet.

d. Make counts of bacteria in the water.

3. Chemistry

   a. Test soil.
   b. Apply fertilizer.
   c. Test either pond or stream water for dissolved oxygen content.
   d. Monitor air and water pollution.

4. Ecology

   a. Study the web of life, the water cycle, and all the interlocking relationships of organisms to their environment and to others of their own kind.

   b. Study the effect of pollution and other man-made problems on environment.

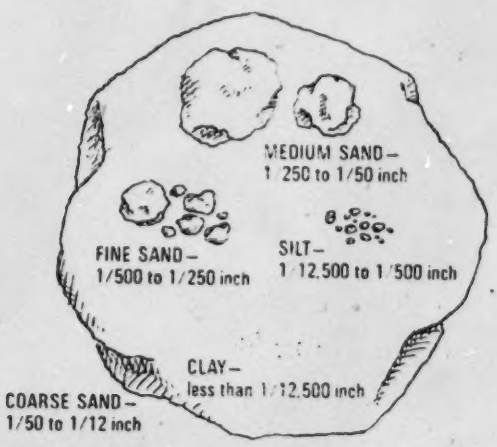
   c. Study plant succession.

5. Home Economics

   a. Practice gardening and outdoor cooking.
   b. Plant shrubs or trees to beautify the school ground.
   c. Study edible wild plants such as pokeweed, dandelion, and wood sorrel.

Are All Soil Particles the Same Size?

Sand, silt, clay are groups of particles. Individual particles vary greatly in size. See diagram.



Sand, silt, and clay are designations based on sizes of mineral particles. The texture of soil is determined by the blend of these various sized particles. Diagram shows particles enlarged about 30 times.

6. Geology and Soils

a. Determine the different kinds of soil and classify them according to their characteristics.

b. Test soils for acidity, alkalinity, potassium, and phosphorus.

c. Analyze sedimentary geologic formations.

d. Find areas on which soil erosion is occurring and determine causes of erosion.

e. Collect rocks from streambeds and classify them.

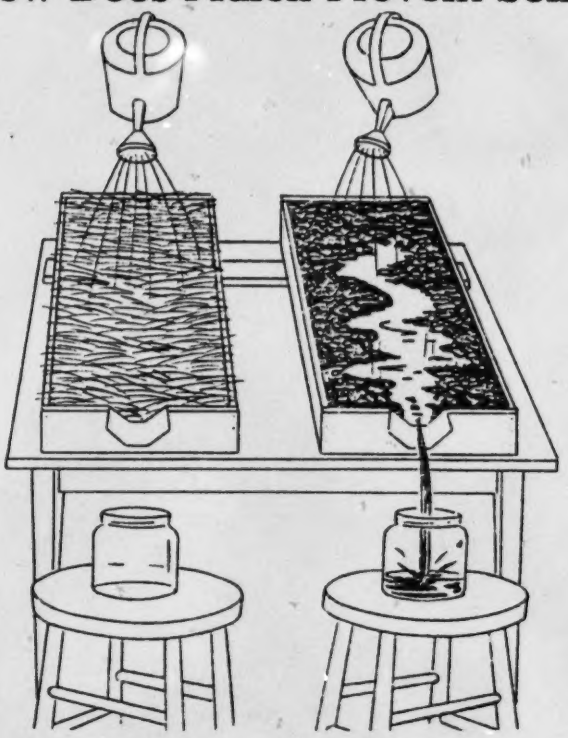
f. Study soil temperature at different depths and list factors that influence soil temperature.

g. Compare the depth of topsoil at different locations and in different drainageways.

h. Examine various strata for fossils and develop a method of classifying the fossils.

i. Compare the amounts of organic matter in soil samples.

How Does Mulch Prevent Soil Loss?



7. Plants

a. Survey, classify, and compare plants that grow in wooded areas, along streams, and in open areas.

b. Find evidence on plants of either insects or diseases, or both.

c. Locate flowering and non-flowering plants.

d. Locate green and non-green plants.

e. Record the different kinds of trees in the outdoor classroom and list their common characteristics.

f. Compare methods by which plants in the outdoor classroom scatter their seed.

g. In different plant communities, mark off small plots, about 1 yard square. In the plots, compare types of plant and animal life, the amount of bare ground to that covered by vegetation, light intensity, temperature, soil moisture, soil compactness, and water absorption rates.

h. Estimate the ages of living trees and the amount of water given off by a particular tree through transpiration.

i. In abandoned fields, identify various stages of plant succession and compare types of vegetation in each.

j. Prepare a vegetation map of the outdoor classroom.

k. Take pictures of plants, especially for students interested in photography.

l. Make a collection of seeds and record the environmental conditions under which each is found. Determine their requirements for germination.

m. Make a study of plants that can be used for both food and dye.

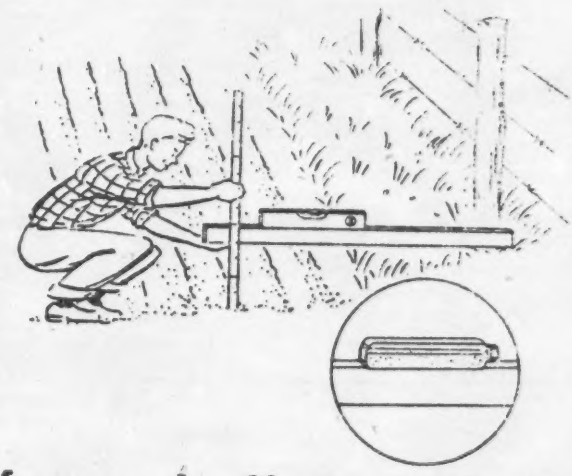
n. Make a study of poisonous plants.

o. Plant grasses, flowers, shrubs, or trees.

8. Vocational Agriculture

a. Help plan and apply conservation measures.

b. Practice land judging, forest management, fishpond management, and other types of resource management.



Measure the Slope of a Field

c. Study the value of ratural areas, good farming practices, and habitat management for wildlife.

9. Weather

a. Launch helium-filled balloons to follow weather fronts and jet streams. Place the name and address of the school inside the balloons so that the information can be returned.

b. Plan and operate a weather station. Compare temperatures at different places in the outdoor classroom. Make weather forecasts.

c. Compare different kinds of clouds and relate them to weather conditions.

d. Determine acidity and alkalinity of both stream water and rain water.

e. Keep records of air pressure and relative humidity and relate them to kinds of weather.

B. Mathematics

1. Measure heights and diameters of trees.
2. Measure distances.
3. Compute the surface area of irregularly shaped areas.
4. Prepare contour maps.
5. Measure slopes and elevations.
6. Compute the volume in different trees.

C. Social Studies

1. Examine the area near the outdoor classroom and list ways in which man has disrupted nature.
2. Identify state agencies and local authorities who help control pollution and write to them for information on pollution.
3. Review both city ordinances and state laws relating to the control of pollution.
4. Photograph examples of pollution in both the neighborhood and community.
5. Determine the economic value of wild plants, especially for medicines, foods, and dyes.
6. Review published material and make a written report on the origin of your town--when it originated and why.
7. Study a nearby historic site.
8. Write a report on the visit of a famous person to your town.

9. Investigate the uses and abuses of public lands.

D. Language Arts

1. Learn the meaning of words that are commonly used by those who write or speak on the subjects of environment, ecology, and conservation. Make the words a part of your vocabulary.

2. Find out why certain animals and plants were given their names. Example: The ovenbird is named for the shape of its nest.

3. Write a theme describing an environmental experience such as the beauty of the outdoors, the abuse of nature by man, and the waste of natural resources.

4. Identify and describe natural sounds in the out-of-doors such as bird calls, wind, rainfall in a forest, and a waterfall.

5. Write articles on pollution in the community for publication in the school newspaper.

6. Write a description of the region as it will appear in another 25 years if man continues to abuse nature at the present rate.

7. Make field notes of important, unusual, or interesting things observed while outdoors.

8. Make a list of old superstitions and sayings about the out-of-doors.

9. Choose something that appears at first to be ugly--for example, a snake or an insect; then, describe the object after looking at it carefully.

10. Write a play concerning man's activities and their effects upon the environment. Activities should include those that have both good and bad effects. Have students perform the play--they learn quickly by acting.

11. Older students are effective in teaching younger students; therefore, they can write informative material about features in the outdoor classroom and present it to younger students.

E. Art

1. Make either pencil or charcoal sketches of plants in the outdoor classroom.

2. For decorative bouquets, make arrangements of dried grasses and other plants.

3. Take photographs in the out-of-doors, with emphasis on either color or black-and-white.

4. Use pebbles, seeds, or plants and create pictures on a slab of wood.

5. Help develop a landscape plan for the outdoor classroom. Use native plants.

F. Music

1. Compose songs or ballards based on outdoor experiences.

2. Sing songs about nature.

3. Observe natural rhythms and sounds.

G. Shop

1. Build walls and walkways.

2. Build birdhouses and feeders.

3. Build signs if needed for nature trails, interpretive displays, or for other uses.

H. Physical Education

1. Practice hobbies such as archery, fishing, and hiking.

2. Play Indian games and other outdoor games.

3. Study outdoor health and sanitation.

I. Health and Safety

1. Identify edible plants.

2. Identify poisonous plants.

3. Practice common first-aid.

4. Learn the safety rules for hiking.

5. Identify potential safety hazards in and near the outdoor classroom. Determine what is needed to correct the hazards.

J. Journalism - Nearly all high schools and many junior high schools publish school papers. The reporters are delighted to cover the development of outdoor classrooms and activities associated with them.

K. Clubs - Camera clubs can document activities. Ecology clubs, 4-H clubs, FFA, and others can actually sponsor and develop parts of the outdoor classroom.

L. Quotations - A class can select appropriate quotations and place them at various locations in the outdoor classroom.

M. Nature by the Square Yard - A plot of ground, 1 yard square, can be set aside in an open field, on the edge of woods, or in deep woods. Many lessons in conservation and ecology can be taught, using this plot of soil with its plants and animals.

Make a Conservation Corner

APPENDIX I - GLOSSARY

Adaptation: An inherited characteristic that improves an organism's chances for survival in a particular habitat.

Algae: The simplest of all green plant forms, having neither roots, stems, nor leaves.

Annual: A plant that completes its life cycle from seedling to mature seed-bearing plant during a single growing season and then dies.

Biotic community: An association of plants and animals living in a common area and having effects on each other.

Catkins: The inflorescence of a plant, consisting of a spike bearing only pistillate flowers or only staminate flowers, which eventually fall from the plant.

Climate: The average long-term weather conditions of an area, including temperature, rainfall, humidity, wind, and hours of sunlight.

Climax community: The relatively stable community that represents the end result of succession under existing conditions of soil, climate, and other environmental factors.

Community: All the plants and animals in a particular area that are bound together by food chains and other interrelations.

Conservation: The use of natural resources in a way that assures their continuous availability to future generations; the wise use of natural resources.

Deciduous plants: Trees and shrubs which shed their leaves in the fall.

Dioecious: Plants which are of one sex, having the male and female elements in different individuals.

Ecology: The scientific study of the relationships of living things to one another and to their environment.

Ecosystem: The combination of the biotic community interacting with the physical environment.

Ecotone: An area of transition between one type of habitat and another; the ecologist's term for a transition zone.

Energy flow: The process through which energy from the sun is passed from one living organism to another.

Entomology: The scientific study of insects.

Environment: All the external conditions surrounding a living thing.

Evergreen plant: A plant which keeps its leaves in the fall and loses them gradually throughout the year.

Exotic: A plant or an animal that becomes established in an area where it is not native.

Floodplain: Low-lying flatlands bordering a river and made up of sediments carried by the stream and deposited during floods.

Food chain: A series of plants and animals linked by their food relationships. A mosquito, a mosquito-eating frog, and a frog-eating bird form a simple food chain.

Food web: An interrelating system of food chains.

Fungi: A group of plants lacking chlorophyll, roots, stems, and leaves. Some fungi are of importance as decomposers of organic matter.

Genus: A group of closely related species. All cottonwoods, for example, belong to the same genus.

Habitat: The immediate surroundings of a plant or animal; the living place.

Hibernation: A prolonged dormant or sleep-like state that enables an animal to survive during the winter in cold climates.

Humus: Submicroscopic organic particles resulting from the decomposition of dead plants and animals.

Incomplete metamorphosis: The type of life history characteristic of certain insects, such as dragonflies and grasshoppers, in which there is no pupal stage. Instead, the immature insect or nymph undergoes a series of gradual changes as it transforms into the adult.

Invader: A plant that grows on bare, usually disturbed soil.

Larva: An active immature stage in an animal's life history, during which its form differs from that of the adult. In the development of the mosquito, the larva is the "wiggler"; in the butterfly it is the caterpillar; and in the frog it is the tadpole.

Metamorphosis: A change in the form of a living thing as it matures, especially the transformation from a larva to an adult.

Molt: To shed a body covering, such as the external skeleton of an insect.

Nutrients: That which provides nourishment and promotes growth, usually in the form of inorganic elements or organic substances.

Organic: Pertaining to anything that is alive, ever was alive, or produced by a plant or animal.

Overgrazing: Excessive feeding on the vegetation of an area by wild or domestic animals. Overgrazing results in serious and often lasting damage to the area's ability to support desirable plant life.

Perennial: Any plant that continues its growth from year to year. In perennial herbs, the parts above ground die in the fall and are replaced by new shoots in the spring.

APPENDIX II - BASIC REFERENCES

A. Reference material available from nearly all county offices of the Soil Conservation Service

1. Slide Talks:

"Outdoor Classroom Ideas"
"Outdoor Classrooms--Where Do We Go From Here?"

2. USDA publications:

Teaching Soil and Water Conservation--A Classroom and Field Guide, PA341

Outdoor Classrooms on School Sites, PA975

Environmental Education in Action--An SCS Environmental Quality Aid, reprinted from "Soil Conservation Magazine."

B. Film: "An Approach to School Site Development," for rent from the National Association of Conservation Districts, Environmental Film Library, League City, Texas 77573.

C. People and their Environment, a set of eight curriculum guides on conservation education. One volume is "Outdoor Laboratories." Available from J. G. Ferguson Publishing Company, 6 North Michigan Avenue, Chicago, Illinois 60602. Price is $3.40 per volume.

D. Ten Minute Field Trips, an illustrated teacher's guide to short ecology field trips for elementary grades. Available from the same source as "C" above. Price is $4.85 per volume.

E. Urban Environment, Grades K, 1, 2, and 3. Contains a curriculum guide to conservation education specifically for teachers of early elementary grades in urban areas. Available from the same source as "C" above. Price is $4.85 per volume.

F. 100 Teaching Activities in Environmental Education, a publication containing over 100 activities in environmental education. It is designed for students in grades kindergarten through 12. Each activity is classified according to grade level, subject matter, environmental concept, and environmental problem. The purpose of each activity is stated, and the student is referred to either more detailed information on the activity or to variations in it. Available from the ERIC Center for Science, Mathematics, and Environmental Education, 1800 Cannon Drive, 400 Lincoln Tower, Ohio State University, Columbus, Ohio 43210.

G. Teaching Activities in Environmental Education, Volume II, a follow-up publication of "F" above. It contains 168 additional activities.

H. Tips and Tricks in Outdoor Education by Malcolm D. Swann. This 184-page book contains 13 chapters some of which are conducting field experiments, animal studies, nature arts and crafts, outdoor recreation, and weather. It is available from Interstate Printers and Publishers, Inc., Danville, Illinois 61832.

I. Outdoor Education Equipment by Russell E. Bachert, Jr. and Emerson L. Snooks. This 197-page book contains aids for teaching subjects pertaining to the out-of-doors. The aids are inexpensive and easy to assemble. Published by the Interstate Printers and Publishers, Inc., Danville, Illinois 61832.

J. Environmental Education and your School Site by Donn Paul Werling. This handbook defines a process in which the student body, school personnel, and the community are involved in planning and developing the school site as a "green island" for use by both the school and the community. Published by Open Lands Project, Chicago, Illinois 60604.

K. Ten educational cartoon booklets and accompanying teacher's guides . The booklets are:

1. "The Story of Land"
2. "The Wonder of Water"
3. "Help Keep our Land Beautiful"
4. "Making a Home for Wildlife on the Land"
5. "Food and the Land"
6. "Working Together for a Livable Land"
7. "Plants--How they Improve our Environment"
8. "The Earth--Our Home in Space"

9. "Plants, Animals and Man Sharing the Earth--An Ecology Story"
10. "Pioneers of Conservation in America"

Over a million of these booklets are sold each year. Children and grownups alike enjoy the booklets which are printed in comic book format but have a powerful environmental message. Prices range from 8 to 30 cents for each booklet and teacher's guide, depending on quantities ordered. Order from Soil Conservation Society of America, 7515 NE. Ankeny Road, Ankeny, Iowa 50021.

L. A Child's Garden by Chevron Chemical Company, Public Relations, 200 Bush Street, San Francisco, California 94120. An excellent guidebook for gardening on school grounds.

M. Manual for Outdoor Laboratories by the National Association of Biology Teachers. Available from Interstate Printers and Publishers Inc., 19-29 No. Jackson Street, Danville, Illinois 61832.

N. Outdoor Education on your School Grounds--An Action Approach to Better Teaching by Norman F. Marsh. It is a manual for junior high school teachers. Available from the Resource Agency, Office of Conservation Education, Sacremento, California 95814.

O. My Land and Your Land Conservation Series, published by the National Wildlife Federation, 1412 Sixteenth Street NW, Washington, D.C. 20036. The series contains ideas for outdoor studies and conservation projects. The series contains four parts:

"Would You Like to Have Lived When--?"
(Grades 3, 4, 5).

"Raindrops and Muddy Rivers"
(Grades 4, 5, 6).

"Plants and Animals Live Together"
(Grades 5, 6, 7).

"Nature's Bank--The Soil"
(Grades 6, 7, 8).

P. Man and His Environment, an introduction to using environmental study areas. Available from National Education Association, 1201 Sixteenth Street, NW, Washington, D.C. 20036.

Q. Conservation Education: A Selected Bibliography by Joan Carvajal and Martha Munzer, published by the Conservation Education Association. One of the most complete bibliographies available today. It is especially designed for teachers. Available from Interstate Printers and Publishers, Danville, Illinois 61832.

R. Trail Planning and Layout, B-4, National Audubon Society, Information-Education Bulletin No. 1, National Audubon Society, Nature Centers Division, New York, New York 10022.

S. Manual of Outdoor Conservation Education, B-3, National Audubon Society, Nature Centers Division, Information-Education Bulletin #1, New York, New York 10022.

T. Manual of Outdoor Interpretation, B-6, Information-Education Bulletin #1, National Audubon Society, Nature Centers Division, New York, New York 10022.

U. A Nature Center for Your Community, B-1, Information-Education Bulletin #1, National Audubon Society, Nature Centers Division, New York, New York 10022.

V. Environmental Education Act (P.L. 91-516) Handbook on Preparing Proposals, published by U.S. Department of Health, Education and Welfare, Office of Education. Documents criteria and information required when applying for a grant to be used in developing an outdoor environmental project.

W. General References:

1. Magazines, Periodicals, Newspapers

National Wildlife
National Wildlife Federation
1414 - 16th Street, NW
Washington, D.C. 20015

Ranger Rick
National Wildlife Federation
1421 - 16th Street, NW
Washington, D.C. 20015

Curious Naturalist
Massachusetts Audubon Society
Lincoln, Massachusetts 01773

Journal of Outdoor Education
Editor: George Donaldson
Box 299
Oregon, Illinois 61061

Environmental Education
Editor: Clay Schoenfield
Box 1605
Madison, Wisconsin 53701

Environmental Education Bulletin
National Park Service
Western Region
450 Golden Gate Avenue
San Francisco, California 94102

The C. F. Letter
The Conservation Foundation
1250 Connecticut Avenue, NW
Washington, D.C. 20036

Conservation Vistas
U.S. Forest Service
P.O. Box 3613
Portland, Oregon 97408

Environment Magazine
438 North Skinner
St. Louis, Missouri 63130

The Outdoor Teacher
Southern Illinois University
606 1/2 South Marion
Carbondale, Illinois 62901

Conservation News
National Wildlife Federation
1421 - 16th Street, NW
Washington, D.C. 20036

Conservation Education Newsletter
Editor: Edward Dolder
The Resources Agency
1416 Ninth Street
Sacramento, California 95814

2. Either free or inexpensive materials are available from:

National Audubon Society
Nature Center Division
1130 Fifth Avenue
New York, New York 10028

National Wildlife Federation
1412 Sixteenth Street, NW
Washington, D.C. 20036

Superintendent of Documents
Government Printing Office
Washington, D.C. 20036

Conservation Foundation
1250 Connecticut Avenue, NW
Washington, D.C. 20036

Forest Service
U.S. Department of Agriculture
Washington, D.C. 30350

Fish and Wildlife Service
U.S. Department of the Interior
Washington, D.C. 20240

The Wilderness Society
1901 Pennsylvania Ave., NW
Washington, D.C. 20015

National Parks Association
1701 - 18th Street, NW
Washington, D.C. 20037

National Parks Service
U.S. Department of the Interior
Washington, D.C. 20240

Soil Conservation Service
U.S. Department of Agriculture
Washington , D.C. 20250

American Forest Institute
1619 Massachusetts Ave., NW
Washington, D.C. 20036

Alabama Department of Conservation and
Natural Resources
64 No. Union Street
Montgomery, Alabama 36104

National Association of Conservation Districts
P.O. Box 855
League City, Texas 77573

Alabama Forestry Commission
513 Madison Avenue
Montgomery, Alabama 36104

Bureau of Land Management
U.S. Department of the Interior
Washington, D.C. 20240

APPENDIX III

TEACHING AIDS

A. THE TREE --

LIFE GIVER OF THE FOREST

Trees--life givers of the forest

Trees benefit man

Leaves of trees

Bark of trees.

TREES--LIFE GIVERS OF THE FOREST

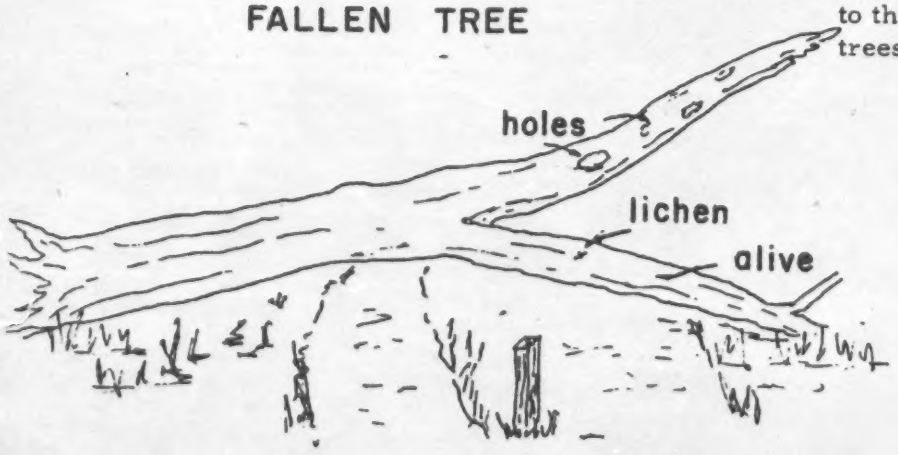
1. Trees provide homes for animals. They provide animals with protection from predators and weather.

2. Some insects live in trees and their food comes from trees. Certain birds and other animals, in turn, eat the insects that live in trees.

3. Mosses, lichens, and other plants either live in trees or on them.

4. When they die and decay, trees enrich the soil. A fallen tree, especially one that is partially decayed, offers many opportunities for teaching. In all probability, lichens can be found on the bark. There may be holes made by squirrels, woodpeckers, or other animals. These attest to the many functions of trees in the "web of life." Worms, insects, numerous other small animals, and fungi can be observed in their important roles as decomposers. Although the fallen tree is dead, new growth may be coming

FALLEN TREE



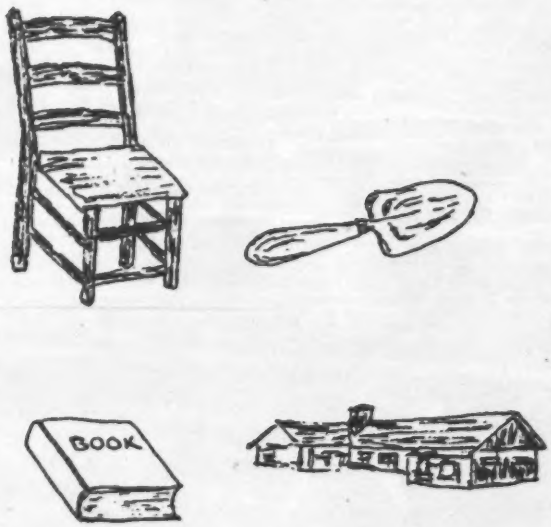
from the roots. If so, the new growth affords the opportunity of observing and discussing one of nature's ways of perpetuating a living thing.

Activities

1. Discuss the animals and plants which are directly related to a particular tree in the outdoor classroom. List the animals that live in trees, preferably a separate list for birds, insects, and mammals.

2. Discuss the tree's age and estimate how long it will live. Discuss decomposition of dead trees and list plants and animals that are important decomposers.

TREES BENEFIT MAN



Too often we overlook the ways in which trees benefit man. Benefits are both esthetic and functional. Trees provide us with shade in the heat of summer and with shelter in the cold of winter. They provide us with paper products which we use so extensively and with many other useful things such as desks, chairs, and handles for tools. Some trees provide food in the form of nuts, fruits, and other products--for example, pecans, apples, and maple syrup.

Activities

1. From his earliest days on earth, man has used trees. List the uses he has made of them since the time that most men lived in caves and other primitive shelters.

2. As stated earlier, we use many products made from trees. Make a list of those at home and at school that are made from either trees or their by-products.

3. Discuss the importance of trees, wood, and their by-products to the economy of the community, county, state, and region.

LEAVES OF TREES

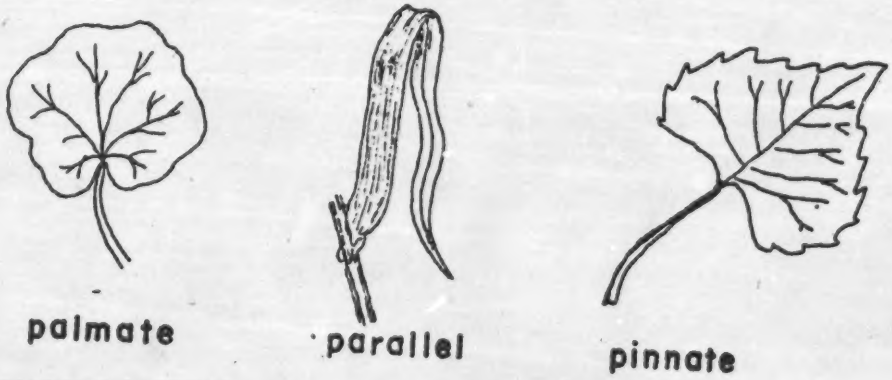
Trees make their own food. The leaves gather energy from the sun and along with water and nutrients taken up by the roots, make food for the trees. In this way, trees and all other green plants differ from animals--animals cannot make their own food. Leaves have many different shapes and characteristics. These vary according to the species of trees on which they grow. Variations in shape and other characteristics of leaves help in identifying trees.

Trees are of two kinds--deciduous and evergreen. Deciduous trees shed most of their leaves at one time, usually in the fall. For the most part, they are bare during winter. Evergreen trees, on the other hand, shed their leaves gradually throughout the year. They remain green the year round.

Activities

1. Collect leaves from different kinds of trees and notice their differences such as veins, shape, size, and color. Identify the trees from which the leaves were collected.

VEINATION



2. In the fall, study and observe the shedding of leaves from deciduous trees.

deciduous evergreen

BARK OF TREES

The bark is very important. It protects the tree somewhat like our skin protects us. The tree's vital growth cells lie just under the bark. They need protection from physical damage and from insects and diseases.

Bark can be used in identifying trees because each kind of tree has a different kind of bark. For example, the bark of a yellow-poplar is different from that of a hickory, an oak, a sweetgum, and all other kinds of trees in the area.

Activities

1. Study the bark of trees and its importance to them.

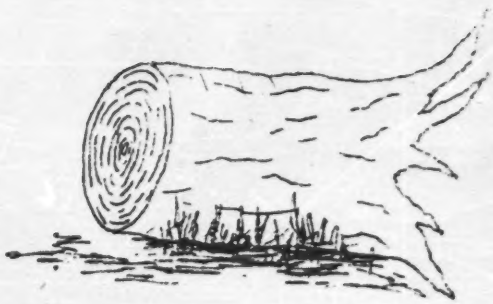
2. Study the different colors and patterns on the bark of trees.

B. ROOTS AND RINGS

Trees and roots

Growth rings

Tree growth and history

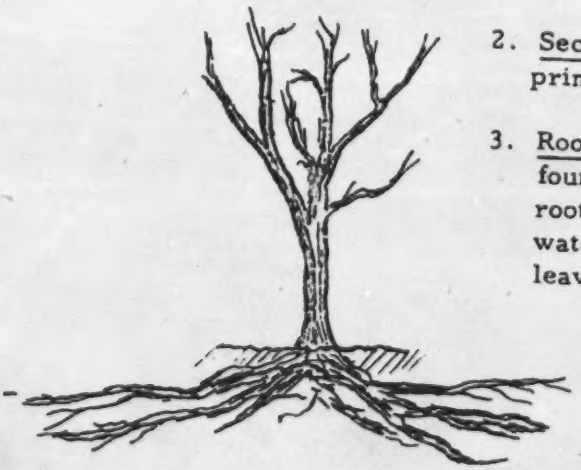


TREE ROOTS

Roots are vital to trees. They absorb water and nutrients from the soil. In the presence of sunlight, the leaves combine the water and nutrients with other elements and make food for trees. (This is an example of photosynthesis.) Roots enable trees to stand upright and to withstand normal winds. In some places, especially in dry places, the roots of certain trees grow straight down until they reach moist soil. But the roots of certain other trees are shallow. They spread out fairly close to the top of the ground, especially in damp places.

The root system of trees contains three major types of roots--primary roots, secondary roots, and root hairs.

1. Primary roots are the largest roots. They are connected directly to the trunk.



2. Secondary roots branch off the primary roots.

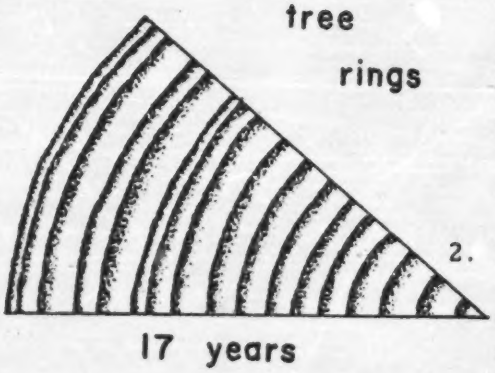
3. Root hairs are the smallest. They are found on both primary and secondary roots. Root hairs absorb most of the water and nutrients from which the leaves make food.

Many people compare the root system with the part of the tree above ground. Actually, they are about the same size. In addition, the primary roots are comparable to the trunk and main branches. The secondary roots are comparable in size and number to the smaller branches and twigs; and the numerous, small root hairs are comparable to the leaves.

Note: Colorful, informative, and interesting pamphlets on tree growth, leaves, growth rings, and other subjects are available from:

St. Regis
150 East 42nd Street
New York, N.Y. 10017

Activities



1. Observe other plants and their root systems. Compare root systems of plants in dry areas with root systems of plants in wet areas. Discuss whether or not root type is related to the amount of moisture available to plants or whether each species of plant has the same kind of root system.

2. Investigate the various root systems and discuss their development. Collect different kinds of roots from plants around the school, home, neighborhood, and community. Label and preserve them.

3. Have students compare the three types of roots (primary, secondary, and root hairs) and determine which is most efficient in absorbing water and which are better for storing large amounts of food.

4. Discuss ways in which man uses the different types of roots to improve his living conditions.

GROWTH RINGS

Every year, a tree adds a growth ring just under the bark. Actually, it is a layer of wood. It represents the growth made by the tree during the year. During spring, when growth is rapid, walls of the growth cells are thick; and the wood is light in color. Growth is slow during summer and fall. Cell walls are thin at that time, and the wood is dark.

The age of a tree can be determined by counting the growth rings on its stump. Often, the rings reveal other interesting information, also. Width of the rings varies from year to year, depending on growing conditions. They are wider during years of rapid growth--years when plenty of water and sunlight are available. They are thinner during years of poor growth. Some reasons for poor growth are diseases, insects, lack of water, and lack of space. Frequently, scientists read the stories that rings tell. From them, they learn much about things that occurred long before man started keeping records.

Growth rings are only one of the interesting ways by which nature makes accurate records of happenings. There are many others.

Activities

1. Have students determine the age of a tree by counting the growth rings on either a stump or a log.

2. Discuss the width of growth rings and have students write a report on growth conditions during the life of the tree. In the report, have them list factors that could have caused changes in growth.

3. Discuss the season during which trees grow most rapidly and have students list reasons for rapid growth during that season.

4. Compare the growth rings of hardwoods with those of softwoods. Discuss the structure of their growth rings, rates of growth, and environmental effects such as wind, altitude, moisture, and growing space.

TREE GROWTH AND HISTORY

After the age of a tree is determined, interesting events which occurred during its lifetime can be discussed. Among the events that can be discussed

are: 1. The population of a well-known, nearby town when the tree started growing--either the town in which the school is located or the county seat is suitable;

2. The use that man was making of the school site at the time the tree started growing;

3. The diameter of the tree at the beginnings of World Wars I and II;

4. Diameter of the tree at the time of Lindbergh's solo flight across the Atlantic;

5. Diameter of the tree when students were born;

6. Diameter of the tree when students' parents were born and others. These discussions will be both interesting and educational, especially for history classes.

Either a tree stump or a section of log can be used for studying growth rings. If a section of log is used, one end should be buried. The log or stump selected should be as old as possible so that growth over a long period of time can be studied.

To prevent cracking and decay, paint the top of the stump and both ends of the log as soon as they are cut. If not painted, they won't last long.

Use one part of penta concentrate mixed with nine parts of mineral spirits. For best results, apply three coats. Applications should be heavy. Apply the first coat as soon as the tree is cut and the "hinge" is removed. Apply the second coat in about 2 weeks or after the first coat has dried. If the stump or log needs additional smoothing, it should be smoothed after the first coat dries and before the second application. Apply the second coat in about 2 weeks or after the first coat has dried. Apply the third coat in about 2 more weeks or after the second coat has dried.

C. GRASS AND GRASSHOPPERS

Grasses

Grasshoppers, mosquitoes and insect habitat

Beneficial and harmful insects

GRASSES

The grass family is the most widely distributed and by far the most valuable family of plants known to man. Grasses are man's primary source of food, both directly and indirectly. Cultivated grasses such as wheat, oats, and corn provide him with flour for bread and grain for cereal. Many domestic animals feed upon grasses. They, in turn, provide man with a variety of foods and products such as meat, milk, ice cream, wool, and leather.

Grasses also carpet the land, thereby preventing both water and wind erosion. The Dust Bowl of the 1930's resulted from man's failure to recognize the importance of grass in preventing erosion.

Corn is Alabama's most important cultivated grass. It is the State's most important grain crop, also. Actually, corn is a gift from the Indians. The The Indians, of course, had no well equipped agricultural research stations. By modern standards, they knew very little about breeding plants. But over the centuries, they took a wild grass and made it into an aristocrat among cultivated crops. They did it without the aid of laboratories, greenhouses, and other facilities and equipment commonly used by modern plant breeders.

The Indian used only his patience, unaided eye, bare hands, imagination, and dedication. He selected the more

desirable mutations; and by doing so for a long time, he domesticated corn--one of our most valuable grasses.

Besides corn, other grasses of importance to agriculture in Alabama are bahia, barley, bermuda grass, Dallis grass, fescue, Johnson grass, millets (many varieties), oats, orchard grass, rye, wheat, and others.

Lawn grasses commonly used in Alabama are bermuda, centipede, St. Augustine, zoyzia, and others.

Many of the wild grasses are important for grazing and preventing erosion.

western wheat-grass

Activities

1. List the common grasses in the area and indicate their uses.
2. List grasses that are important to man in various parts of the world and in the United States.
3. Write a report on the importance of grasses to man. In the report, discuss ways in which grasses contribute both directly and indirectly to man's welfare, especially by providing food and clothing.

GRASSHOPPERS, MOSQUITOS, AND INSECT HABITATS

A warm grassy field or meadow provides much different habitat for insects than does a shady wooded area. And each area supports different kinds of insects. The grasshopper, for example, prefers the warm grassy field; the mosquito, on the other hand, prefers the shady wooded area.

The grasshopper has a tough outer covering which enables him to withstand the direct rays of summer sun. His green and brown coloring blends well with his surroundings and helps conceal him from his enemies.

Unlike the grasshopper, the mosquito is rarely seen in warm grassy fields, especially in mid-day. The mosquito dehydrates rapidly in warm sunny areas. Therefore, for the most part, the mosquito stays in moist shady places.

As one goes from a warm grassy field into a moist wooded area, he notices a sudden change in the kinds of insects. Why? Because insects, like all other living things, have definite habitat likes and dislikes. Some insects prefer dry areas with low-growing vegetation; others prefer moist areas with high-growing vegetation.

MOUTH PARTS

butterfly
sipping

grasshopper
chewing

mosquito
sucking

Activities

1. Count the grasshoppers in a small grassy field.

2. Observe the protective coloration on a grasshopper and discuss the importance of color to the grasshopper.

3. Discuss ways in which insects are especially adapted to their habitat and way of life. Ways should include color, mouth parts, ability to fly, and ability to climb.

4. List the different kinds of insects found in a warm grassy area and describe the characteristic habitat of each. List those found in moist wooded areas and describe the characteristic habitat of each.

BENEFICIAL AND HARMFUL INSECTS

One must carefully watch insects at work to fully appreciate their value to man. Here are some ways in which they are beneficial:

Some insects improve the soil. Air enters the soil through holes made by ants, grubs, beetles, and wild bees. Burrowing insects also bring soil to the surface from the deeper layers, thereby improving soil texture and burying decaying matter. The grubs or larvae of insects that feed on wood--certain beetles, ants, termites, and tiny insects such as the springtails--are constantly at work tearing

to pieces leaves, twigs, and trunks of fallen trees. This returns the wood to the soil where it provides nutrients for other plant growth.

Some insects are of value to man because they catch and eat harmful insects. Among these are the dragonflies, damselflies, aphis-lions, ground beetles, and lady bird beetles. Others are the ant-lions or doodle bugs, robber flies, tiger beetles, wasps, and ants.

The dragon fly is beneficial because it catches and eats mosquitoes. Its highly developed eyes and speedy flight enable the dragon fly to catch in flight mosquitoes and other small insects on which it feeds.

The praying mantis is an odd-looking relative of the grasshopper. It is about 4 inches long and can catch, hold, and eat large insects. The name comes from the attitude that the praying mantis assumes as he rests or stalks his prey.

Both the young and adult lady bird beetles kill and eat various soft-bodied insects. Their combined action in destroying eggs and young of destructive aphids, scales, and other soft-bodied, plant-feeding insects is of great value to those who raise crops and flowers.

Insects are of great value as pollenizers of plants. Many serve mankind in this way- thrips, butterflies, ants, beetles, flies, wasps, and bees. About 50 seed and fruit crops either depend on honeybees or yield more satisfactorily because of their presence. Red and white clovers, onions, most varieties of apples, sweet cheeries, and plums would be barren without insect pollinators.

Silk originates in the spittle of an insect. To a large extent, silk is being replaced by man-made fibers. But silk production is still important in parts of the world--China, Japan, India, and the Mediterranean region. In China and Japan, thousands of families care for silkworms as part of their daily activities during the summer.

Many other insects are beneficial, but many are harmful also. Some are both beneficial and harmful. For example, the blow fly maggots, after they have helped dispose of dead animals may become disease-bearing flies.

In the opinion of most people, the grasshopper and mosquito are harmful to man. The grasshopper may feed upon plants which provide man with either food or clothing. The bite of the mosquito annoys man. And sometimes the mosquito transfers parasites to man and to animals upon which man depends. The parasites that cause malaria and yellow fever in man and the dreaded heartworm in dogs are examples.

In addition to the grasshopper and mosquito, other harmful insects are the boll weevil, the bollworm, the pea weevil, the chinch bug, bark beetles, subterranean termites, roaches, cattle grubs, houseflies, army worms, screw worms, and others.

As his life becomes more complex, man must itensify his search for ways to improve his living conditons. Better methods of controlling harmful insects is only one of man's current problems. How can he either control or eliminate the harmful ones without harming the beneficial ones? How can he reduce harmful insects and at the same time have little or no effect on natural food chains and food webs, including those that involve man himself? These are some of the questions for which research is seeking suitable answers. There are many others.

Activities

1. Discuss beneficial and harmful insects.

2. Make a list of beneficial insects and indicate ways in which they are beneficial.

3. Make a list of harmful insects and indicate ways in which they are harmful.

4. Discuss advantages and disadvantages of using insecticides. Determine whether or not insecticides are being used in the area served by the school. If so, determine the purpose for which they are being used.

5. Make a written report on either the honeybee or the boll weevil. In the report, discuss both life history and economic importance.

D. THE MONARCH BUTTERFLY

The Monarch Butterfly

Both moths and butterflies belong to the insect order, Lepidoptera. The monarch butterfly is a colorful member; and like the rest of the order, it undergoes complete metamorphosis. Other insects, such as the grasshopper, which do not have complete metamorphosis make an interesting contrast. In any case, insects make fascinating subjects for nature study. They are numerous and easily observed in any environment. They are both interesting and educational.

The monarch is more widespread in America than any other butterfly and is also one of the best known varieties. Frequently, the larva or caterpillar stage can be found on milkweed plants. Milkweed is the only plant upon which the larvae feed, and they are usually found feeding on the underside of the large rubbery leaves.

By having complete metamorphosis, the monarch goes through four distinct stages of development which are egg, larva, pupa and adult. Development takes about a month. It starts with the laying of an egg on the underside of a milkweed leaf. This stage of development lasts 4 or 5 days. The monarch usually deposits only one egg per leaf and never more than three per plant. This prevents a catastrophe from wiping out her whole brood. The eggs are minutely small and pale green. They resemble dew drops.

After 5 days or more the egg hatches and the larva stage begins as a very small caterpillar. For 12 days, the caterpillar eats continuously, both night and day. It stops only occasionally for rest. During this period, it molts several times. Each time it molts, its size increases. Soon

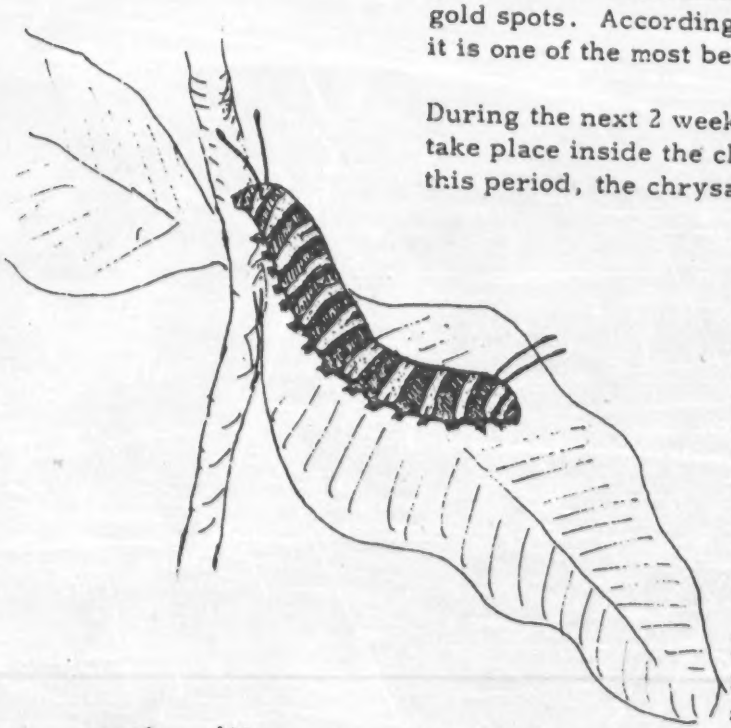
it is 2 to 3 inches long. By then, the striped caterpillar is ready to begin its pupal stage. Its color is yellow, black, and white.

When the caterpillar is ready to pupate, it leaves the milkweed plant, traveling up to 300 feet in search of a twig or leaf in some safe place. It then spins a tiny drop of silk from glands in its mouth. The silk is used to attach the caterpillar's tail to the plant. From there it hangs head downward and curled up, forming a capital "J". Shortly thereafter, the skin splits away and the emerging pupa or chrysalis hardens in the air. It remains dangling from the support by the thread-like attachment.

pupa — chrysalis

The monarch chrysalis, unlike most other butterfly chrysalises, is beautiful. It is smooth, waxy, and of the richest shade of green. It is decorated with several brillant gold spots. According to many naturalists, it is one of the most beautiful objects in nature.

During the next 2 weeks, many transformations take place inside the chrysalis. Near the end of this period, the chrysalis begins to turn black and orange, the color of the forming butterfly inside. Shortly thereafter, the butterfly emerges leaving its hollow shell behind. For the next 2 hours or more, fluids are pumped into the wrinkled wings to make them rigid and strong. Shortly thereafter, the Monarch is off in flight.

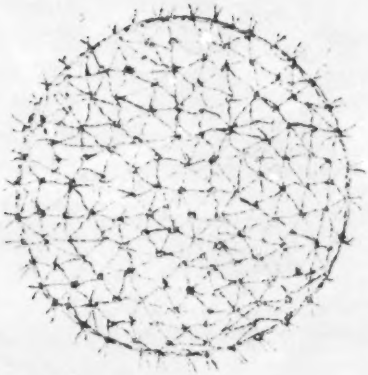


caterpillar on milkweed

During the first 3 days of its adult life, the monarch spends most of its time feeding on flower nectar. After then it feeds only occasionally.

As fall approaches, the monarchs gather and head southward in mass migration. They follow several migration routes across the United States. In the spring of the following year, some return to lay eggs and to spend the summer months.

This has been only a brief summary of the monarch's life, but it can serve a useful purpose. The story of metamorphosis is fascinating, especially of the monarch. But many other common insects have lives just as interesting as that of the monarch. Many of these can be found and studied on the school ground.



volvox

E. LIFE THROUGH A LENS

Students can see more in the outdoor classroom if they have aids to help the eye. Binoculars are especially useful for observing birds and other animals that cannot be closely approached. Hand lenses are also good for close-up study of insects and for studying the tiny parts of a flower. But the microscope is probably the most revealing of all. Even the simplest microscope opens up an entirely new world.

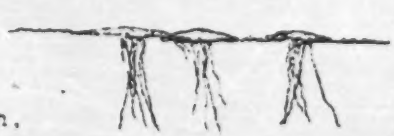
It is difficult to use a microscope in the field, of course. For that reason, microscopes are rarely taken to the field. Instead, materials are collected in the field and brought back to the classroom for viewing.

If the outdoor classroom contains a small pond or if a creek runs through the school ground, these offer excellent possibilities for exploring the microscopic world. Many one-celled animals and small plants can be captured in the pond or creek, placed in a jar, transferred to a glass slide, and viewed through the microscope.

To obtain good samples, use three or four jars. Take samples from the surface of the water, just under the surface, at the middle depths, and from the bottom. By doing so, a wide variety of life from the different micro-communities in the water are more likely to be found. Organisms found in the different samples can be compared.

Collecting

1. Use clean jars and lids.
2. In obtaining a sample, close the jar and lower it to the desired depth. Then, slowly open it, capturing material at that depth.
3. Avoid upsetting water while taking samples, especially from ponds.



duckweed

spirogyra

4. When taking samples from the bottom, add decayed matter and some mud.

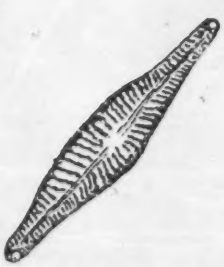
5. When taking samples from the surface, pond scum and duckweed may be encountered. If so, add them to the jar with the pond water because a world of microscopic life lives around them.

vorticella

Duckweed. A microhabitat surrounds the small filamentous rootlets of floating duckweeds. The roots, less than ½ inch long, hang down under the water. They are shaded and protected by the small leaves overhead. Here many organisms such as diatoms, filamentous blue-green algae, and vorticella are found either stuck to or wound around the roots.

Spirogyra is a common filamentous green alga found on the surface of ponds and lakes. It is the most common form of pond scum and can be easily viewed through a microscope with a magnification of 150.

Volvox is a green alga, also. But it is very different in form from spirogyra. It consists of a large hollow sphere made up of a colony of cells. Each cell has an eyespot and two flagella. As flagella beat, volvox rotates and rolls through water. It is not as easy to find as some of the other pond organisms, but its beauty is certainly worth looking for.



diatom

Diatoms are microscopic single-celled yellow-green algae. They have unique shapes resembling inanimate objects such as a pillbox. Most diatoms can be seen through a microscope with a magnification of 300.

euglena

Euglena is a plant, but it can be classified as an animal because of its ability to move independently. Euglena is common in ponds that contain a great deal of organic matter. Euglena may give the water a bright green color. It has a single flagellum and a conspicuous red eyespot.

cyclops

Cyclops are small crustaceans that are very common in ponds. They have antennae about as long as the trunks of their bodies. They feed on algae, bacteria, and organic debris. They are about a twelfth of an inch long.

paramecium

Paramecia are one celled animals that feed on algae, yeast, bacteria, and decaying organic matter. They have many small flagella that propel them through the water. They can easily be observed through a microscope with a magnification of 50.

F. BIRD FEEDERS

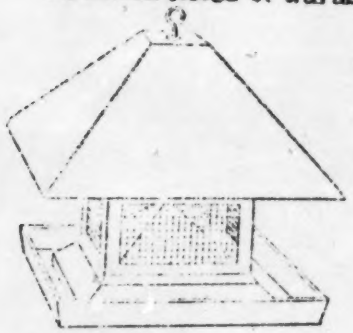
Birds have three basic requirements--food, cover, and water. Food limits both the number and variety of birds on many Alabama areas

For most birds, food is more abundant during spring, summer, and fall. It may become critical during winter.

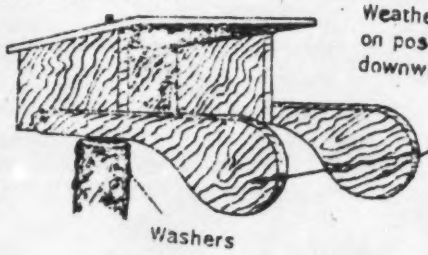
There are many ways of providing food for birds. One of the best ways is with feeders. Feeders are especially recommended for bringing birds close in around homes and schoolhouses, particularly during late fall, winter, and early spring. But after birds become accustomed to feeders, they visit them throughout the year even during periods of food abundance.

Bird feeders are available from pet shops, department stores, feed and seed dealers, and other places. Many types are available. The most common are a tray or shelf, a self-feeder or hopper, a small wire-mesh container, and a cavity. The latter includes such things as a coconut, a limb, or almost any container into which a small hole can be drilled--a small tincan with a hole in one end is suitable.

Self-feeders and wire-mesh containers are generally recommended because they reduce waste and protect food from droppings. It is not necessary for feeders to be expensive and elaborate. Students can build their own. They should be constructed of durable materials.

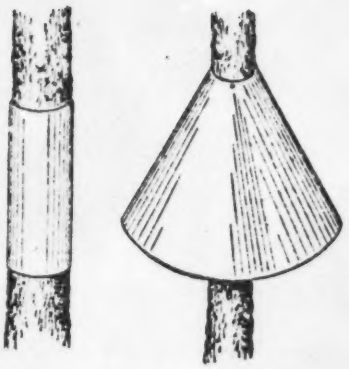


Food hopper
(roof detachable)



Coconut shell with one end sawed off, a perch installed, and a screw eye for hanging from tree limb by wire. Fill with suet, nuts, seeds, or other suitable food.

Place feeders in the open where the birds can see and be seen. Protect feeders from climbing animals by suspending them from a thin overhead support such as a tree limb. Feeders may also be placed on a post that is either covered with sheet metal or has a sheet metal guard such as a joint of stove pipe to discourage climbing animals.



Sheet metal guards to help protect feeders from climbing animals.

To protect birds from northerly winter winds, place feeders on the southern or southeastern side of the schoolhouse or an evergreen thicket. Place them several feet from such shelter. This allows birds to be in the open where they can watch for danger while feeding.

Here are some foods that are readily eaten by various birds:

Woodpeckers--Suet, cracked nuts, corn.

Jays--Suet, cracked nuts, corn, peanuts, sunflower seed.

Titmice, chickadees, nuthatches--Suet, cracked nuts, shelled and broken peanuts, sunflower seed, bread crumbs.

Mockingbirds, catbirds, thrashers, hermit thrushes, robins--Cut apples and oranges, currants, raisins, bread crumbs.

Starlings--Cut apples, currants, raisins, suet, corn, shelled and broken peanuts, scratch feed.

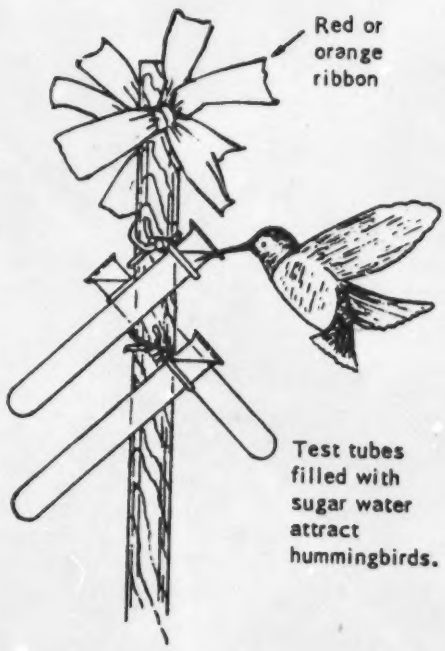
Juncos, finches, sparrows--Scratch feed, millet, wheat screenings, small seed mixtures, bread crumbs.

Grains, fats, nuts, and fruits are the main foods that attract birds. Almost any of them can be successful. Grains are the easiest to put into feeders, and they attract the greatest variety of birds. Mixtures are better than a single kind of food. Nuts should be cracked, but the meat need not be extracted. Large fruits such as apples and oranges should be cut into smaller pieces. Make only a few foods available at any particular time and place. Put food into feeders at regular intervals and discard spoiled food.

The four main foods--grains, fats, nuts, and fruits--may be combined in a food cake. Here is a recipe for combining them: Mix 1 cup of bacon grease or any other grease that solidifies, 1 cup of sugar, and 5 cups of water. Boil this mixture. Then, add 2 cups of cornmeal, ½ cup of flour, and 2 cups of cold water. Make smooth by stirring

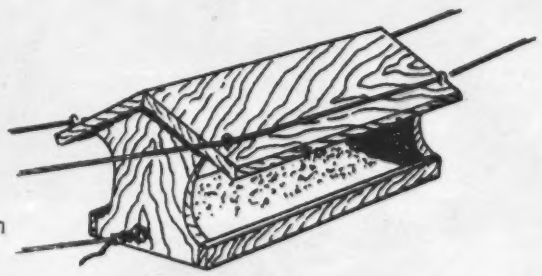
until thick. Then, add 1 cup of raisins, seeds, or nut meats as desired. Pour into pan, keep in refrigerator, and slice off as needed.

Hummingbirds are easily attracted in season. Merely tie a few strips of red or orange ribbon around a cluster of three or four test tubes. Hang tubes on a stake or among shrubs. Keep tubes filled with sugar-water. Make sugar water by mixing one part sugar with three parts water. Check tubes often. Hummingbirds seldom approach empty tubes.



Test tubes filled with sugar water attract hummingbirds.

A trolley feeder is recommended for bringing birds to within a few feet of a window. It is a roofed tray suspended on tight wires between a window sill and a tree or post. Put food into the feeder at the window sill. Then, pull it by a hand line to the far end where birds are more apt to find the food and become adjusted to feeding without fear. After they become accustomed to the feeder, move it closer to the sill. Repeat until birds are feeding close by.



A trolley feeder suspended on wires is virtually cat-proof. By drawing it a little nearer each day, birds can be coaxed right up to the window.

Several feeders are usually better than a single one because certain birds tend to drive others away from a single source of food. Several feeders also tend to increase the variety of birds because a single location may not be suitable for all species.

Trained personnel in the local office of the Soil Conservation Service can give you more information on bird feeders. More information is available, also, from the County Extension Chairman, Alabama Department of Conservation and Natural Resources, National Audubon Society, Alabama Ornithological Society, and others.

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Conservation Pledge
I GIVE MY
PLEDGE AS AN AMERICAN
TO SAVE AND FAITHFULLY TO
DEFEND FROM WASTE THE
NATURAL RESOURCES OF
MY COUNTRY — ITS SOIL
AND MINERALS ITS
FORESTS WATERS
AND WILDLIFE
U.S. DEPARTMENT OF AGRICULTURE-SOIL CONSERVATION SERVICE